TensorFlow Quantum: A Software Framework for Quantum Machine Learning

Abstract

We introduce TensorFlow Quantum (TFQ), an open source library for the rapid prototyping of hybrid quantum-classical models for classical or quantum data. This framework offers high-level abstractions for the design and training of both discriminative and generative quantum models under TensorFlow and supports high-performance quantum circuit simulators. We provide an overview of the software architecture and building blocks through several examples and review the theory of hybrid quantum-classical neural networks. We illustrate TFQ functionalities via several basic applications including supervised learning for quantum classification, quantum control, and quantum approximate optimization. Moreover, we demonstrate how one can apply TFQ to tackle advanced quantum learning tasks including meta-learning, Hamiltonian learning, and sampling thermal states. We hope this framework provides the necessary tools for the quantum computing and machine learning research communities to explore models of both natural and artificial quantum systems, and ultimately discover new quantum algorithms which could potentially yield a quantum advantage.